013113

JPRS 82407

7 December 1982

West Europe Report

SCIENCE AND TECHNOLOGY

No. 129

FBIS FOREIGN BROADCAST INFORMATION SERVICE

10
34
A03

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

PROCUREMENT OF PUBLICATIONS

JPRS publications may be ordered from the National Technical Information Service, Springfield, Virginia 22161. In ordering, it is recommended that the JPRS number, title, date and author, if applicable, of publication be cited.

Current JPRS publications are announced in Government Reports Announcements issued semi-monthly by the National Technical Information Service, and are listed in the Monthly Catalog of U.S. Government Publications issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Correspondence pertaining to matters other than procurement may be addressed to Joint Publications Research Service, 1000 North Glebe Road, Arlington, Virginia 22201.

JPRS 82407

7 December 1982

WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

No. 129

CONTENTS

 [III - WE - 151 S&T]

BIOTECHNOLOGY

BRIEFS

ITALIAN BIOTECHNOLOGIES PLAN--Italian scientific research minister Giancarlo Tesini has announced a five-year plan for the promotion of biotechnology. The plan calls for expenditures amounting to 128 billion lire, of which 76 billion lire are to be supplied from the funds based on Law 46 on Technological Innovation. The remaining 52 billion lire are to be financed by private industry. The National Research Council will make an additional 13.5 billion lire available for research projects in this field. The plan is designed to guarantee not only follow-up projects for the work of the CNR (National Research Council), for which the latter has already provided 18 billion lire, but beyond that, it is supposed to provide incentives for technological innovation in the fields of chemistry, electronics, metal processing, and medicine. [Text] [Duesseldorf EUROPA CHEMIE in German 19 Aug 82 p 390] 5058

FRANCE AIDS BIOTECHNOLOGIES--The French government continues to assign great importance to biotechnology as one of the seven "brood mares" of the government research and innovation program. As we can tell from the recently submitted 3-year program, about 40 major projects are to be promoted in this field which is highly important for the future. Some of these projects deal with basic research in the area of enzymes, microorganisms, as well as animal and vegetable cells; others deal with biological methods which so far have been neglected in France, such as cell breeding, development of bioreactors, as well as separating and purification methods. Last but not least, research projects oriented toward practical application are also to be promoted; they deal with the production of chemicals, medications, and food products as well as environmental protection aspects. The comprehensive program is supplemented by the training of experts as well as the transfer of knowledge to industry. The public is to be familiarized with biotechnology and objections are to be explained through a broad publicity effort. France is to spend Frl.1 billion for the above-mentioned projects this year. In 1983, the figure is to be Frl.4 billion. Most of this money will be supplied by industry. By 1990, French biotechnology production is to amount to 10 percent of the world market which currently has been given at a figure of Fr250 billion. [Text] [Duesseldorf EUROPA CHEMIE in German 7 Aug 82 p 372] 5058

CSO: 3698/42

BRIEFS

FUNDS FOR CHEMICALS INDUSTRY--About half of the Fr9.9 billion, which the French government is making available to nationalized industrial enterprises in 1982, goes to the chemical industry. The lion's share of Fr2.4 billion goes to the "Pechiney Ugine Kuhlmann SA" nonferrous metal concern. Furthermore, Fr1.26 billion have been set aside for "Rhone Poulenc SA" and Fr400 million were earmarked for the "Cie de Saint-Gobain SA" glass and tube concern. "CdF Chimie SA" is to get Fr600 million and its affiliate, "Entreprise Miniere et Chimique SA" will get Fr200 million. The flow of money fell considerably below the expectations of the enterprises because fund requests had to be cut back drastically on account of the heavy budget deficit. About Fr3 billion are in each case contributed out of the total sum as capital pump priming operation by the government to the government-owned National Investment Company as well as in the form of partnership loans. An amount of Fr350 million has been set aside for new projects. [Text] [Duesseldorf EUROPA CHEMIE in German 7 Aug 82 p 372] 5058

CSO: 3698/42

SPAIN, FRG TO BUILD WORLD'S LARGEST SOLAR POWER PLANT

Madrid EL PAIS in Spanish 25 Oct 82 p 62

/Article by Antonio Fernandez Gil/

/Text/ Almeria--Luis Magana Martinez and Jose Maria Fluxa Ceva, on behalf of and representing the CEE (Center for Energy Studies) and the ASINEL (Association for Industrial Electrical Research), respectively, signed a cooperative agreement Friday. In principle it is for 1 year, but it may be renewed for a period of 1 year at a time until completion of the technological development program (GAST), foreseen for 1985. The program is being carried out at the Tabernas solar platform (Almeria).

The GAST project is represented by the model of solar installations with a central tower, whose utilization makes possible the production of electricity through the convergence of thousands of luminous beams on a mirror called a heliostat. By virtue of the agreement just signed, the solar platform at Almeria will soon begin the experimental testing of critical components for the development of the GAST project, for which the Governments of Spain and the FRG will construct a 20,000-megawatt solar power plant in our country, with a total investment of more than 20 billion pesetas.

As is known, in Almeria there is already an operational solar power plant programmed by the International Energy Agency, which is currently developing the project Small Solar Power System, generating 0.5 megawatts of power. And functional tests will soon begin for the Almeria Solar Electric Power Plant (CESA-1), a 1.2-megawatt project administered by the CEE.

Management and coordination of the project will be the responsibility of ASINEL, which will also be responsible for construction, operation, maintenance and evaluation of CESA-1, as well as the customary services of health, security and cleaning of the solar platform.

For its part, the CEE will provide ASINEL sufficient space for the GAST installations, also facilitating the use of the CESA-1 infrastructure under the principle of mutual cooperation without interference between the two projects.

For the signers of the agreement this act represents a very important step not only to test the viability of power plants of this type, but in developing a specific advanced technology. The electrical sector now reckons with the first solar power plant utilizing high-temperature gases at 1,000 degrees centigrade and with new designs for heliostats at 60 percent under their normal cost.

9746
CSO: 3698/45

BRIEFS

SPANISH PHOTOVOLTAIC POWER PLANT--Madrid--The largest photovoltaic solar energy power plant in the world will be built in the near future at Guadalix de la Sierra, near Madrid, and will have a power of 100 kw, according to the terms of an agreement signed on 30 July between the Ministry of Industry and several private firms. This solar power plant will be the first of its kind built in Spain and will cost 466 million pesetas (28 million French francs). Among the objectives of this project is the long-term installation in Spain of photovoltaic solar power plants that can rival the conventional energy sources from the standpoint of production cost. [Text] [Paris AFP SCIENCES in French 5 Aug 82 p 29] 9969

CSO: 3698/20

FRENCH RESEARCH FOURTH-GENERATION COMPUTER TECHNOLOGY

Paris L'USINE NOUVELLE in French 16 Sep 82 supplement pp 6-8

[Article by Jacques Antoine]

[Text] The limited market for big scientific computers--a few hundred machines--explains their near absence from computer exhibits such as the SICOB [Trade Industries and Office Management Exhibit]. But from these poorly known computers the fourth generation of computers will emerge--the supercomputers of the next decade.

Scientific applications require many more highly complex numerical calculations than do management or process control applications. "In the beginning, they worked with military problems, territorial defense and surveillance, ballistics, satellites, etc.," says Jean-Claude Syre, a staffer at the CERT [Toulouse Study and Research Center], an ONERA [National Office of Aerospace Studies and Research] facility. Now they are being expanded to some major civilian applications: meteorology, seismology, plasma physics, aero and hydrodynamics, resource studies, simulations of various large systems, etc."

These scientific applications demand programs whose processing time in our conventional computers is prohibitive. The time required is either incompatible with the problem to be treated--as is the case with real-time processing of satellite images--or with the average rate of failure of the computer system. "For NASA's Space Shuttle, for example, spending 50,000 hours in a wind tunnel is just not possible. So they have to break down the study by using computer simulations, after first dividing the problem into parts and simplifying the equations. Even then, a simulation still takes about 10 hours of computer time. NASA's goal is to bring it down to a quarter of an hour."

The power of an average computer of the present third generation, of the CII-HB 66/80 or IBM 370/158 type, ranges

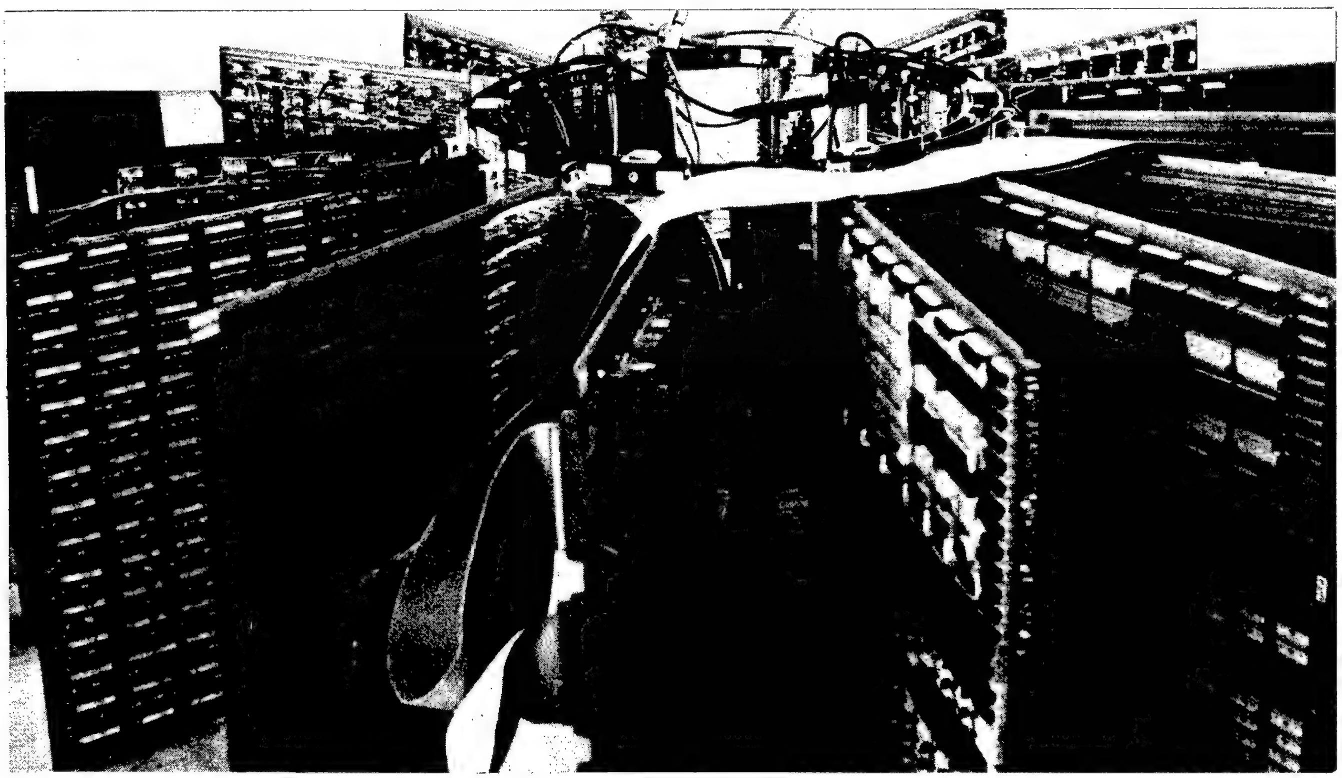
between 0.5 and 2 Mflops (megaflops or millions of operations per second). These essentially paltry performances are related to the monoprocessor architecture used for computers ever since their early days (this type of architecture is sometimes called von Neumann architecture). A corollary of this architecture is their sequential functioning. For these machines, the problem to be solved is translated into a sequential language of elementary instructions: either a Fortran, Basic, Assembly, or similar program. The machine reads these instructions one after the other and executes them, by issuing for each instruction a sequence of orders in the processing unit. Even if the processor and the central memory now use the same technology, which means they can be intimately integrated, it is still true that the limited speed of communication between these two functional entities will remain a fundamental handicap. "If we want to go a little faster, perhaps 5 to 10 times faster," said Jean-Claude Syre, "we can still rely on technology for semiconductors integration. And to go beyond that, up to now we have made strictly structural modifications, but not fundamental modifications in the organization of the computer."

Interconnected memories and pre-memory units are used to reduce the access time to the central memory. "We can also reduce the time of execution of an instruction by dividing it into different stages, each handled by sub-systems of the processing unit." Here we find an overlapping of the different operations, producing the "pipelined" structure of these computers. This is the type of structure used for the most powerful computers presently available on the market, such as the Amdahl 470/V6, the Control Data, CDC Star 100, the Cray 1, or even the Cyber 203. These machines can reach theoretical speeds of 100 to 200 Mflops. But in practice, they rarely exceed 10 to 50 Mflops, for outside the field of vector calculations in which they excel, they are machines like any others, just faster.

So we are still far from the 1,000 to 10,000 Mflops that the scientists will want within the next 10 years. What is the answer? "Technological changes to improve these monoprocessor systems will not be enough. We will have to use radically different types of architecture," explain the Toulouse specialists. This will bring in computers with several processing units (multiprocessor architecture), connected in parallel and working on the same program. "By sharing a big program among a large number of these units, we can decrease its apparent total execution time."

A first concept of this type has been developed, with the SIMD [Single Instruction-Multiple Data Stream] machines, or matrix computers of the Illiac IV type (64 processors in parallel), Staran, or, in France, the Propal 2 of Cimsa. Here each processor performs the same elementary operation as all the others, but each works on different data. Such high performance computers for vector operations remain generally underutilized, though, as the programs are not limited to such operations. In addition, the execution is still sequential. In short, according to the specialists, this is "an unsatisfactory long-term solution."

Now we will leave the area of machines available on the market, to move to the area of research and projects preparing for the fourth generation of computers. These are MIMD [Multiple Instruction-Multiple Data Stream] systems, in which different operations on different data can be executed simultaneously, no matter where they appear in the program. So there is an asynchronous stream of operations to be executed in parallel, coming from different parts of the program. This marks the end of the "sequential" type of system.



Prototype of the future MIMD-type supercomputers. In 1979 the Lau machine was the only one operational anywhere in the world.

Associating Several Processors Working in Parallel Operation

The Toulouse computer specialists explain that we have to abandon the conventional execution of a program operated by sequential instructions and turn to an execution mode determined by the data. So, no matter where the instructions may be in the program, the computer performs the associated operations as the operands are calculated, and thus become available. Contrary to what happens in a conventional computer, "this parallelism and asynchronism of execution require that each variable can receive only a single value during the execution of the program. This condition, known as single assignation, is the foundation of data directed programming." Inevitably, it will revolutionize--unlike the preceding approaches--programming methodology (algorithms, etc.) and will also require changes in programming languages: automatic translation, or even new languages.

The CERT group has demonstrated the feasibility of this new approach. With the financial support of the SESORI, which is today the ADI [Data Processing Agency], and the noteworthy assistance provided by Jean Gualino, a member of the World Computer Center in Paris, in 1979 this group presented its LAU [Single Assignation Language] system, the only MIMD prototype operational on a world level at the time, 3 years ahead of other groups, such as the one based in Manchester. This was a system with several processing units working in parallel (32 and theoretically unlimited in number), under the control of a single central unit. Then the system can include asynchronisms either between elementary actions (execution in parallel of independent instructions) or between two functions within the same job of a computational type on a grid with a program affecting the frontiers of different domains, and another inside.

Another MIMD system is now being prepared. "This one will have greater consequences in terms of materials and commercial outlets," says Jean-Claude Syre. This project will associate a number (10,000 or more) of processors, but this time they will be complete. Essentially there will be several computers, each with its own control unit, capable of working in parallel on different problems, or all working together on the same problem. With such machines, asynchronism can be taken to a higher level, for example, between two jobs done by the same program. "During aircraft simulations, the nose doesn't always have a great deal to do with the rear aileron. So we could do two calculations at the same time, by means of a synchronization on the frontiers." This is still in the project phase.

In France, research on such large systems is essentially supported by the DRET [expansion unknown], primarily for military requirements, and by the ADI. In addition to the CERT group, some universities (Compiegne, Nice, etc.), the IRISA [Data Processing and Random Systems Research Institute] at Rennes, and the INRIA [National Institute of Data Processing and Automation Research] are interested in the MIMD systems. In industry, last year the CII-HB began its Isis project for a SIMD vector system which would be its top of the line computer after 1985. CIT-Alcatel also seems to be getting interested in this area, through its subsidiary, Sintra.

In the United States, in 1977 NASA began its NASF [Numerical Aerodynamic Simulation Facilities] project, which has an ambitious goal: to reach 1 gigaflop (1 billion operations per second, using a shifting decimal system). Burroughs and Control Data responded to the call for bids. Burroughs chose a MIMD system, and Control Data stayed with the pipelined structure already used for its Cyber series. But it does seem that the program may be more complex than expected, for the initial date scheduled for completion of this project has been pushed back from 1985 to 1988.

The U.S. firm, Cray Research Inc., is also involved in this field with its Cray 2 which, based on what we know today, will be a MIMD quadriprocessor system using a technology incorporating further improvements. In relation to the present Cray 1 system (a monoprocessor with a theoretical capacity of 80 megaflops), the cycle time will change from 12 nanoseconds (billionth of a second) to 4 nanoseconds, and the company has annouced speeds 6 times higher for scalar operations (management type calculations) and 12 times faster for vector operations (scientific calculations). The expected completion date: within 3 years.

1 to 100 Billion Operations Per Second

Unlike the French and American research, which has been motivated primarily by numerical applications, the Japanese program is oriented more toward artificial intelligence. Last fall, the JIPDEC [Japanese Information Processing Development Center] announced with great fanfare a vast national program to develop fifth generation [!] machines between now and 1990. Included among the 26 topics for research and development, grouped in seven categories, are these data stream machines and other very high speed numerical supercomputers. The Japanese are working toward a goal of 1 to 100 billion operations per

second, using a shifting decimal system (1,000 to 100,000 Mflops). Right now this seems truly phenomenal! Is this just a publicity stunt on the part of the Japanese, as some computer experts said when the announcement was made? "Oh, I take them very seriously," said Jean-Claude Syre.

7679
CSO: 3698/29

PLAN TO SPREAD KNOWLEDGE, USE OF COMPOSITES TECHNOLOGIES

Paris LES ECHOS in French 29 Oct 82 p 8

[Article by J.M.: "ANVAR To Encourage Technology Transfer Between Large and Small or Medium-Size Enterprises"]

[Text] In the past two years, France has resolved to bet on composite materials. First stage: it encouraged the creation of production units (Elf-Toray and PUK[Pechiney-Ugine-Kuhlmann]-Hercules agreements for carbon fibers). Second stage: it is now trying to promote applications.

In line with this, ANVAR [National Agency for the Valorization of Research] has initiated a consultation on composite materials. It is intended to encourage small and medium-size enterprises to venture and contribute to the dissemination of this advanced technology throughout the French society.

Who would have believed 15 years ago that electronic chips would be used in everyday life and would become familiar to the public at large? Mr Maurice Allegre, director of DESTI [expansion unknown] at the Ministry of Research and Industry, likes to predict that the same will happen with composite materials.

Compared with previous ANVAR consultations, the formula used this time was original. A number of large enterprises--either composite materials producers (like Vetrotex, a Saint-Gobain subsidiary specializing in glass fibers) or large users of the new technology (Aerospatiale, Dassault, Bertin, SEP [European Propellant Co.], MATRA [Mechanics, Aviation and Traction Co.])--as well as technical centers (CETIM [Technical Center for the Mechanics Industries], CEMP [Plastics Materials Research Center]) and organizations involved in the development of these materials (CODEMAC [Committee for the Development of Composite Materials], G3F [expansion unknown]) have promised to help the small or medium-size enterprises interested in the rapid development of these new materials.

In the long run, this could result in a transfer of technology. Certainly, the large participating enterprises promised first to provide half a day of free consultation and advice on projects submitted by the small or medium-size enterprises.

But they are not opposed to the subsequent negotiation of a technology transfer agreement... as long as the small or medium-size enterprises do not compete directly with them.

Actually, disseminating knowledge in this field is in everybody's best interest. According to Jean-Michel Yolin, director of chemical industries at the Ministry of Industry, it will make it possible "to reinforce the top of the line by developing the base." Nevertheless, the projects submitted will undergo critical examination.

There are risks involved; small and medium-size enterprises should not get involved unless they have sound financial and commercial bases. This should not be a flash in the pan, but the creation of an industrial fabric with a potential for the future.

9294
CSO: 3698/51

ELF-AQUITAINE, TORAY SIGN DEFINITIVE CARBON FIBER AGREEMENT

Paris LES ECHOS in French 27 Sep 82 p 8

/Article by J.M.: "Carbon Fibers: Agreement Concluded Between Elf-Aquitaine and the Japanese Company, Toray"/

/Text/ The first great French-Japanese alliance in advanced technologies, the definitive agreement between the Elf-Aquitaine group and Toray, the Japanese group, for the creation of a carbon fiber plant in the southwest of France has just been signed. The protocol had been concluded last April.

The two companies are creating a subsidiary in which Elf-Aquitaine holds 65 percent of the capital and Toray, 35 percent. A first production unit with a capacity of 300 tons a year is going to be built within the Lacq complex. It will go into service at the end of 1984 and will allow the creation of approximately 100 highly specialized jobs. The investment planned is 200 million francs.

As soon as the market justifies it, the capacity of the plant will be increased to 600 tons a year and a polyacrylonitrile unit (raw material for carbon fibers) will be added to it. This project will require an additional investment of 250 million francs.

This will be the realization of a plan launched by the previous government and taken up by the Socialist government in order to encourage the world specialists in carbon fiber to settle in France where the only production is that of Serofim (common subsidiary of Carbone Lorraine and Rhone-Poulenc), with a production of 12 tons a year.

PUK /Pechiney Ugine Kuhlmann/ with Hercules

The Japanese Toray, a group with gross sales of $3 billion and employing 30,000 persons, has textile fibers as its primary activity, but for 10 years has been diversifying into carbon fibers where it has become the world leader. While negotiating with the Swiss company Ciba-Geigy in 1981, it had begun conversations with the French company Rhone-Poulenc, then with Elf-Aquitaine. A first project was drawn up between Elf-Aquitaine, Toray and the American company, Union Carbide. Despite the defection of the Americans, Elf-Aquitaine and Toray held out.

Does the result exceed the hopes today? The Pechiney Ugine Kuhlmann group has signed a parallel agreement with the American Hercules for the creation of a carbon fiber plant with a capacity of 200 tons a year at Pont-de-Claix by the end of 1981. So France will find itself with a capacity of 500 tons a year by 1983, while the national consumption scarcely exceeds 100 tons a year. The specialists remain convinced that the outlets for carbon fiber in the aeronautical, automobile and sporting goods industries are going to increase very quickly.

The Elf-Aquitaine group is clearly showing that it has no intention of ignoring fine chemicals. For the past 2 years it has placed composite materials on its research and development programs and is devoting a budget of 10 million to it. And today its communique ends with an opening: "This agreement marks the first step toward a cooperation between Elf-Aquitaine and Toray."

9969
CSO: 3698/20

COMPUTER-AIDED DESIGN WELL ADVANCED AT PEUGEOT

Paris L'ARGUS DE L'AUTOMOBILE in French 9 Sep, 16 Sep 82

[Article by J.P. Gosselin: "Computer-Aided Design at Peugeot. Part 1: Means Used and CAD Structure Design. Part 2: Finite Elements and Simulated Impact Tests"]

[2 Sep 82 p 28]

[Text] Computers: there is the fatal word!... Today, no automobile manufacturer will introduce a new model without announcing "that its essential characteristics--power, weight, fuel consumption--were optimized through scientific computer calculations."

Where? When? How? At what cost? On what computer? These are the questions we asked technicians at Peugeot, a group which always had a daring computer policy, to which it now owes to be a world leader. The answer of Peugeot engineers, Messrs Hamon, Germain-Lacour, Dion, Gonard, Gratadour--to whom we wish to express our warmest thanks--provide much-needed explanations on the techniques and means used to design and manufacture vehicles with steadily improved fuel consumption but with equal (or better) passive safety and a reliability comparable to that of their predecessors.

Increasingly Powerful

Historically, the creation of scientific computation departments at La Garenne, Sochaux (Peugeot), Velizy (Citroen), Carrieres-sous-Poissy (Talbot) dates back to the 1960's. The computers used then appeared incredibly powerful; yet, they would be outstripped by today's microcomputers. Nevertheless, they marked the start of an irreversible process: since then, engineers have kept expecting more from the machines... which were improved, and so forth. The race between the (computer-aided) technicians' brains and the computing power of computers will never stop and is the guarantee of continued progress.

At La Garenne, from 1963 to 1967, IBM 1410 computers were used; from 1965 until 1970, they were replaced by EAI 23IR analog computers that could easily handle integral calculus. In 1967, the IBM 1130 were introduced and, an unprecedented fact, remained in service until 1982. After 1967, the process was accelerated:

from 1968 to 1970, the IBM 360/50; from 1970 to 1975, the IBM 360/65; from 1975 to 1980, the IBM 370/158-3. As can be seen, Peugeot remained faithful to IBM, the American giant, and followed the development of IBM computers which its technicians have fully mastered. In 1978, the still more powerful model PDP 1170 was introduced, and two units installed. Finally, an Amdhal V8 was acquired in 1981; at the time, it was the most powerful scientific computer in the world.

This "superbrain" (which since then has been outstripped only by IBM's Cray 1) then became the center of a complex network connecting all the group's computers, including those of Talbot United Kingdom.

This V8 computer (of a somewhat special type!) can process 10 millions of instructions per second, store in memory several tens of gigabytes (10^9 characters): even working day and night, it is not too powerful to accomplish what is required of it. Relieved from all management operations (which would detract from its scientific computation programs), it is actually connected to the two PDP 1170 units at La Garenne, to the VAX 11/1780 at Velizy, as well as to a host of other smaller specialized computers.

The schema is therefore simple: operations that cannot be performed by smaller computers alone are programmed by them and forwarded to the next higher level (PDP and VAX) where they are either processed or transmitted to the V8 computer. In that case, the smaller computers prepare the work of the superbrain. However, operations at these three levels--specialized computers, medium-size computers, very large computer--is on file in the V8 unit; thus, the group finds itself endowed with a common data bank, especially for geometrical shapes and numerically-determined parts. Thus, the V8 computer installed Quai Andre-Citroen has become both the number-one computer and the file for anything created at Peugeot; according to experts, this very large computer is just barely adequate for the task, but Peugeot paid 15 million francs for it and cannot replace it with a larger one... that would be prohibitive. Still, the staggering cost involved remains "economical"; actually, the price paid for the V8 computer is about equal to the annual cost of leasing the previous very large computer, which was four times less fast and four times less powerful! Consider that a simple graphic station will cost 600,000 to 800,000 francs and that tens of them are needed; you will then have a better idea of the colossal investments required. What most people do not know is that investments are also required for programs, i.e. the instructions given to the machines so they can work fast and well. These programs, the software controlling the hardware (as computers are commonly called), are of vital strategic importance: any company can acquire a very large computer, but it is much harder to make it work intelligently.

The development of programs followed that of computers, and they became increasingly more performing. Without going into details, Peugeot had developed a program, SPACG [expansion unknown], at the same time as UNISURF [expansion unknown], the software developed jointly by Renault and Peugeot for vehicle designing. After breaking up with Renault, Peugeot continued to work alone on UNISURF and is now merging it with SPAC. In spite of this Herculean task, based on the experience acquired during years of operation,

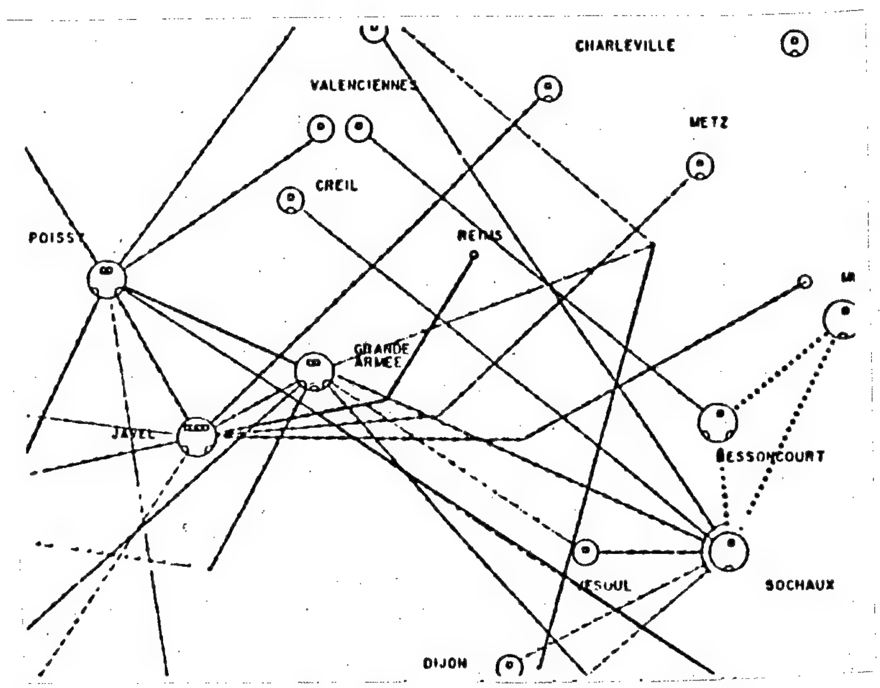


Figure 1. A (simplified and partial) view of the computer network created by Peugeot.

Peugeot is still purchasing software as it becomes available. For instance, NASTRAN (a program sold by NASA!) is perfectly suited for the V8 computer, which also contains the group's program library, preserving in its large memory software such as SPAC, UNISURF, PEG, SAM, etc.

In short, the development of programs during the past 20 years provides a good illustration of the prodigious acceleration of the process:

- In 1965, analog computations on the IBM 1410 could take into account 20-30 degrees of freedom; since each point of a mechanical part has 6 degrees of freedom, it is easy to see what a narrow range was imposed by this type of computer.

- In 1970, the Elvys numerical computation (on an IBM 1130) increased to 60 the number of degrees of freedom.

- In 1976, SAP finite elements (on an IBM 370-158) involved 1,500 degrees of freedom.

- In 1979, the large NASTRAN program (on the Amdhal V8) will integrate up to 20,000 degrees of freedom. We should not forget that a complete vehicle structure is often broken down into 2,000 nodes, i.e. 12,000 degrees of freedom.

Heavy investments, a relentless determination to design ever more powerful software, an impressive mobilization of "grey matter": computers must be extremely useful for automobile manufacturers to devote so much of their substance to them! As we shall see, computers have become absolutely indispensable...

CAD and Structures

CAD--Computer-Aided Design--and CAD/CAM--Computer-Aided Design and Manufacture --are often mentioned although we are not always aware of the revolution they brought about in vehicle designing: from beginning to end, the genesis of a vehicle, its shape, structure, various parts, are preserved in computer memories as numbers. Since these numbers can be instantly displayed on screen, we might think that we are working on drawings, like electronic blueprints, but it is not so. The structures which appear on the display are only the graphic representation of data and computations, and by correcting the drawing it is possible, if desired, to change the numerical data of a part!

It is easy to understand, then, that the numerical data which determine the future automobile constitute a wonderful "red thread" for all who will have to compute it, test it, make it reliable and manufacture it, as modern machine-tools operate directly from such numerical data! All we need is computers powerful enough to process this multitude of figures (which is why we see a scaling up of powers) and programs clever enough (they should not compute anything just for the sake of computing) to make a good automobile. Therefore, the theoretical advantages offered by CAD are that:

- within the same development time, it is possible to design a vehicle that will be lighter, stronger and more efficient than before.

- the quality remaining the same, it is possible to work much faster.

Today, the quality and continuity of software make it possible to say that not only vehicles are better designed, but the time required to design them and start production has been reduced by one year out of five (in the case of the Citroen BX).

As far as structure design is concerned, the first industrial CAD structures realized by Peugeot date back to 1969 for the Citroen Ami 8, and to 1972 for the Peugeot 104. Considerable experience has therefore been acquired. But how do they go about it? It all starts in the styling department where two models of the future vehicles are made, one for the inside, one for the outside. The structure is essentially based on the outside model, the dimensions of which are measured with extreme precision by an Alpha 3D machine. As its name indicates, the machine records the coordinates of the points which determine the "skin" of the car body along three dimensions.

The automobile will be created from this mathematically defined surface! The inner sheetmetal which will fit under the outer "skin" is then automatically designed by specialized programs (which must be highly efficient!). How, then, can it be ascertained that these elements will fit into the car structure? The car is designed (still by computer) in its outline, but can be modified later on to improve the overall design.

Thus, the outside shape is used to determine, by CAD, the shape of the inner sheetmetal, and this does not take much time; a windshield rim requires 1 day of CAD work, compared with 10 days "by hand." The same is true of the siderack (an elongated structure located under the roof panel above the door openings). We could mention many more examples; the more complex the surface, the more time is saved: the displacement of a door needs 2 days of CAD, compared with 2 months "by hand." What about cost? Does it pay to use computers already at this stage? The center pillar of the Visa is estimated to cost 72,000 francs and 930 hours of CAD, compared with 120,000 francs and 2,160 hours "by hand"; these figures need no comments.

Similarly, internal parts will be defined numerically. This time, computations do not even have to be based on the outer "skin," but only on criteria of overall dimensions, operation, feasibility; with a well-developed program, this leads to direct design. For instance, based on a CAD description of the front-axle geometry, its drive-detent parameters, the steering desired, the tires, and other factors roughly determined (not defined) concerning the structure, the brakes, etc., it is possible to design the whole structure of a side of the engine compartment.

Graphically, the "reasoning" of the computer is easy to follow: from a simple diagram, it computes and immediately displays all the possible positions of the wheel (in all, even the worst possible, cases), installs the suspensions at the best possible places (taking the basic styling into account), computes

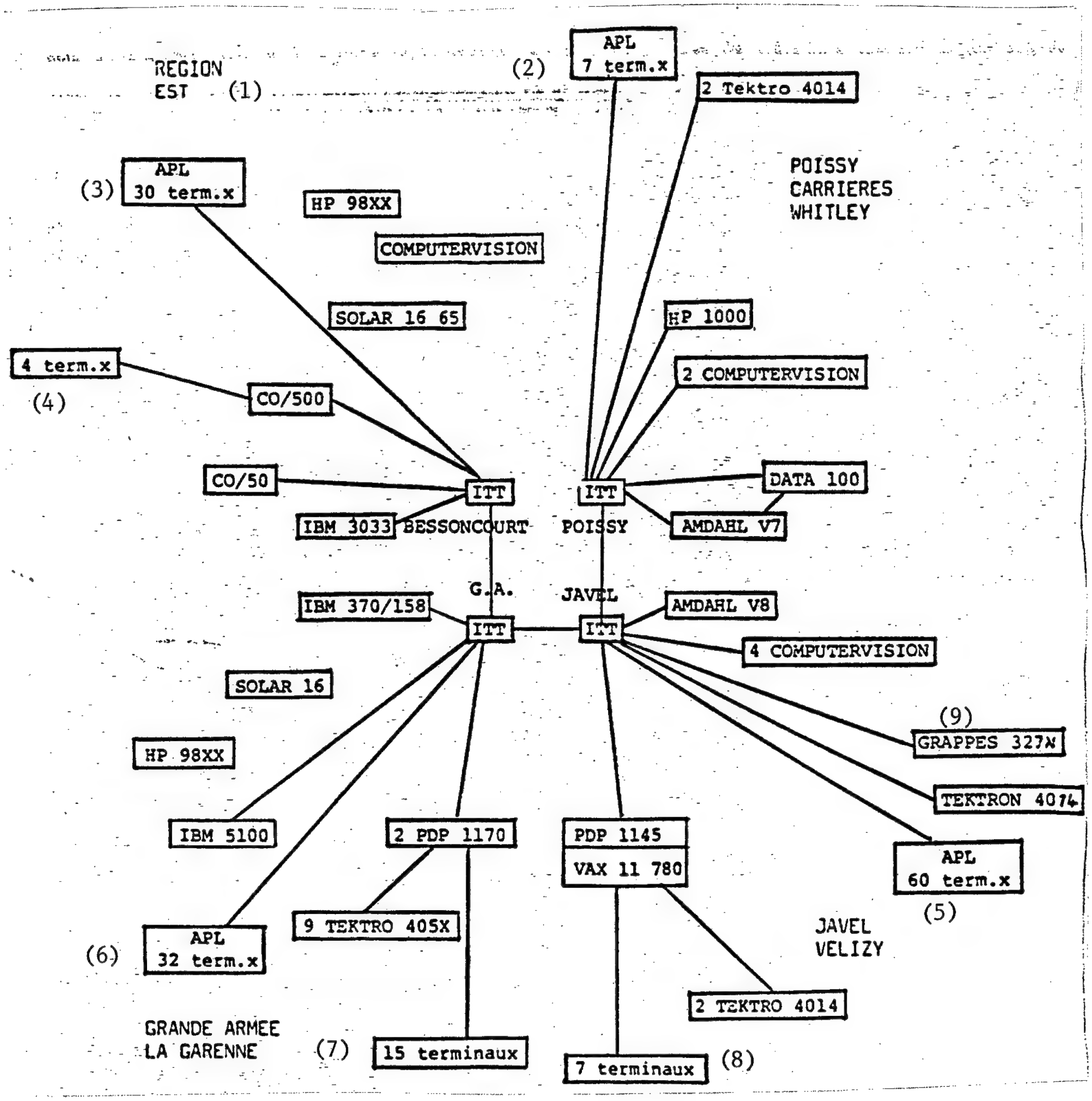


Figure 2. This (simplified) network was that of Peugeot until 1981. Since then, it has been increased and perfected. You will note the variety of equipment used, their high degree of specialization and the fact that they are connected to the Talbot U.K.'s network.

Key:

1. Eastern region
2. APL - 7 terminals
3. APL - 30 terminals
4. 4 terminals
5. APL - 60 terminals
6. APL - 32 terminals
7. 15 terminals
8. 7 terminals
9. 327W clusters

the shock-absorber cup, the wheel well (the technician can make changes on the screen with a magnetic pen) before designing the side rail... The intentions of the designer--as summarized in the specifications--are thus magnificently and quickly materialized. Each part thus created is filed (as blueprints used to be) in a memory level and can thus be superimposed on another; it is thus possible to stack up 256 magnetic blueprints, but only 15 are used, and that is more than enough.

Therefore, all the stamped sheetmetal used in a car body can be designed by CAD. Actually, only 70 or 80 percent, the more complex, are designed by CAD, as Peugeot's computation capabilities are not powerful enough!

Undeniably, the structure is designed ultra-rapidly, but there is more than that to CAD. The quality of the project is considerably improved by its precision and rigor. The fact that everything is computed makes it possible to estimate the weight of the assembly and its inertia with great precision. The equations for each part are known, and they would not have been with a hand-drawn blueprint; therefore, a sort of mathematical prototype is already available and will later on be evaluated, refined, altered, improved... through the actual computation! This is paradoxical: the unlikely amount of computation required to design the structure is nothing compared to what will be required to estimate its strength, even if, thanks to the CAD "red thread," the meshing of design drawings is used as a basis for finite element computing, the second stage in the genesis of the prototype.

In passing, we should note how reliable the software used to design structures based on the engineer's intentions must be, for there is no room left for error. Should a weakness be detected in subsequent stages, it would be necessary to go back to the first program, improve it and start all over again, which would result in a loss of time and money that would cancel the advantages of using CAD. It is easy to understand then why engineers are bent on using the best programs and on creating them if they do not exist. Far from bringing the technical capabilities of manufacturers to the same level, as could have been expected since certain aeronautical and astronautical programs have become available, CAD intensifies competition: the computer will never do more that what men tell him to do, and the genius of the technical team is no longer demonstrated by one model, but by a whole family...

[16 Sep 82 pp 6-7]

[Excerpts] In designing a prototype, therefore, the engineers went from an initial styling model to an outer-conformity model which actually is merely a concrete representation of a mathematical prototype, the actual embodiment of an infinity of points computed from complex equations. After designing the inner sheetmetal structure, installing the mechanical components--and after much computation--the designer has managed to define the entire structure of the new vehicle.

Despite the reliability of CAD programs, nothing can replace the experience gained on a solid sheetmetal prototype: therefore, several such prototypes

(often incomplete at the start) must be built but, before that, why should we not take advantage of our immaterial, purely mathematical prototype to start testing and correct possible errors?

As a result, the meshing defined during the first stage of genesis will be used as a basis on which to compute the structure using the method of finite elements.

Finite Elements

This computing method is based on an operation called "discretization," which consists in dividing the structure into simple elements and in expressing the equilibrium of all these elements using the energy theorems.

Meshing, i.e. the division into discrete elements, and computation preparation are performed on a small local computer: since the result will be an equation system with 10,000 unknowns, the computation proper will be performed later on by the big Amdahl V8 computer. But what are the rules that must be applied to divide the structure into small plane (triangular, quadrangular) or tridimensional (tetrahedral or hexahedral) elements? To say the truth, it is at this stage of designing that the human factor, the engineer's more or less inspired intuition, plays its part, for, when all is said and done, there is no absolute method. Depending on his experience, the designer will find a more or less practical and clever way of dividing his system for computing, but one thing is certain: the finer the meshing, the greater the number of small elements into which the large part is divided, the lesser the risk of error. Therefore, nodes are concentrated in the more heavily loaded zones of the structure and, in some cases, they must be further divided using a smaller size meshing.

Then, inside the computer and using computation, forces will be applied to the structure and its deformations computed. The deformations displayed on the computer terminals are considerably enlarged, up to 1,000 times! Thus, as a body shell seems to twist under torture, its movements and vibrations have fortunately nothing to do with reality, otherwise we would have cars made of something like rubber!

The division into elements, the selection of the nodes, the recording of their coordinates, their assembly and numbering is a long and fastidious operation, but the results are worthwhile. The computations performed on the very large computer using NASA's general NASTRAN program or the specific SAM program, is followed by the no less important reduction stage in which deformation equations and stresses highlight the quality of the structure. If, on the contrary, it reveals weaknesses or can be improved, the operation is started all over again with new structures which again must be meshed so as to increase the control over strength and the reliability of the future car.

The most spectacular improvement, however, remains that of the initial structure design. Since it was designed by a computer, it might be assumed to be perfect from the start, but the engineer, still using the same computing program, can still improve its characteristics to a large extent by modifying a few of them. Thus, a side rail with a bending rigidity of 1 and a torsional

rigidity of 1 for a mass of 1 can be redesigned to a mass of 1.02 (a minimum weight increase) with a bending rigidity of 1.16 and a torsional rigidity of 1.35!

Other figures show both the validity of computing the frequency characteristics of each component and the maximum rigidity obtained through computing.

Another instance of computation shows that a flat body bottom with a frequency of 16.9 Hz would buckle; a different design with ribs giving a good rigidity to the assembly will increase the frequency to 77.8 Hz!

Beyond Mechanics

Finally, an engine cradle (a major assembly including 10,000 degrees of freedom, i.e. as much as a complete body shell) went through 8 successive designs. The computer would compute its deformations during braking at 0.8 G and maximum acceleration in low gear: the mere removal of certain elements and a change in thicknesses (using the same material) resulted in a saving of 1.4 kg of steel out of a total of 7 kg! According to the technicians, they could have gone still further, but they always have deadlines to keep: at Peugeot, this computing power was used primarily to lighten the structure; today, under the accelerated model renewal program, they are essentially concerned with working fast... and they manage to do so.

Reliable and perfectly under control, the finite element method is extending its range of applications and proves powerful in helping design engineers. As far as mechanical strength is concerned, for instance, it can deal with the new plastic and composite materials and with non-linear problems.

It is also used for:

- thermal characteristics, with the difficult computation of thermal fields;

- acoustics, to determine the modes of vibration of empty bodies;

- aerodynamics: the beginnings were encouraging, but the problem is so complex that today's most powerful computers appear ridiculously inadequate. We shall have to wait another two computer generations...

- lubrication: to predict the transmission of efforts;

- combustion: work is in progress, but it is still very difficult;

- engines: the benefits are not as large as in the case of structures. Computations can be made only from a "hand-made" blueprint and it is impossible to go on straight to manufacturing (as is done for stamped parts).

However, one of the most promising developments of CAD is the determination of the behavior of structures under impact. As we shall see, this is one of the strong points of the Peugeot team since, in certain respects, it can be said to have achieved a world first, the invention of computer-simulated testing.

Forecasting

International safety standards require many impact tests to demonstrate that vehicle structures will adequately protect passengers in case of an accident. In addition, the engineer must consider small and medium impacts and how to repair them most economically.

In other words, all that has been defined and computed until now can be thrown back into question. Fortunately, our division into designing stages is entirely hypothetical; in practice, designers continuously synthetize the various constraints. Understandably, it is not easy, and the whole merit of design departments resides in their ability to combine solutions resulting from sectorial studies as diverse (although connected) as:

- layout of the components and of the car interior; outer shape;

- adequate rigidity in operation, vibrations, low-frequency noises and subjective feeling: it should be said that, although flexibility would make the engineer's task easier, it is excluded because the consumer equates it with fragility.

- corrosion;

- feasibility, forming and assembly;

- and, of course, cost.

With respect to impacts, studies are made along two parallel directions:

- finite element computing, i.e. computer-simulated testing, and

- computer-assisted testing.

For instance, consider a side-piece (the front structure supporting the drive-train and suspensions); three aspects of it can be studied through computations:

1. its behavior under a "bumper" effort;

2. the localization of the initial deformations (cost of repair);

3. the analysis of its energy absorption capacity (violent impacts).

The computation approach is standard and, of course, starts with the numerical definition of the part, which is divided into a finite element model with a very fine meshing of 2,221 elements, 1,700 nodes, i.e. 10,200 degrees of freedom. In this computation, nothing is omitted, not even welding spots, contact points and a representation of the structure plasticity...

Equal to 15 Cars

After that, the step-by-step computation of compression begins; as we shall see, it is a Herculean task representative of the power of present-day computers. For each step, and there are 15 of them, the new part characteristics are computed (since the part shape has changed because of contacts and plasticity variations), then the efforts and the compression immediately afterward.

Considering the 10,200 degrees of freedom (the same number as in a full body shell), the V8 computer takes half an hour for each step and, since there are 15 steps, it takes 7-1/2 hours to complete a task that would be nearly impossible on a human scale.

Thus, the following are determined

- the effort/deformation curve, especially the maximum effort;

- stresses throughout the part;

- deformations, zones of weakness which will have to be repaired after an average impact.

The most important fact, however, is that the order of magnitude of the deformations has been determined and their qualitative fidelity verified by a comparison with those observed in actual tests.

Thus, for the first time in the world, Peugeot can simulate impact on a computer and thus accelerate, and increase the reliability of, structure design. This performance was made possible by the purchase of the very large Amdahl V8 computer and the engineers' skills in achieving an ever finer and cleverer meshing, thus proving that Fiat's design department was wrong when it concluded that impact simulation was impossible.

What does qualitative fidelity give to the technicians? Side rails, for instance, are shortened after an impact: the deformations expected were found where they had been expected, and in the same order. Thus, we know where--and between which welding spots--sheetmetal will bend.

Equal to 70 Cars

While we are at it, why not quantify deformations and the deceleration law, this progressive compression, this dispersal of energy which saves passengers' lives? At Peugeot, they hope to achieve this, all the more so--as we have already explained--as robots now provide more uniformity in the strength of welding spots, which makes them more suitable for mathematical processing. The trouble is that each step takes as much time as it takes to compute a whole body shell and that it will take a total of 70-80 steps, compared with 15 today; nevertheless, this is the price to pay to go from qualitative testing (which is becoming common and generates savings) to quantitative testing.

Another factor militates for the generalization of computing, namely the introduction of new materials. Thus, the Vera design required the use of SMC [expansion unknown] plastics, i.e. expensive molds that take a long time to make and cannot be modified: for these obvious economic reasons, they had to be right the first time and computing made that possible. On the Vera, as on all future cars, the weight too must be optimum. On the Vera, the doors are lighter by 35 percent, but just as strong, as was shown by a front impact test at 30° (simulating an actual accident). The programs, therefore, can "digest" materials other than steel and can use their qualities to draw new parts.

As a result, computer-simulated testing results in considerable progress and enormous time-savings in everything that has to do with the safety and weight of future vehicles.

Computer-Assisted Testing

After simulation, computer-assisted testing (CAT) is a profitable extension of computer-aided design. On manufacturers' catapults and launching pads, entire vehicles manned by sophisticated dummies are sent to crash against obstacles. On each dummy, three accelerations are measured for the head, three for the thorax and the pelvis, two efforts for the femur, one for the belt, and one "submarine" effect criteria (when the body goes under the lap belt), i.e. 13 ways per dummy. If you add the structure accelerations and the "buffer" efforts, that makes 72 ways of measuring: since the operation lasts only 150 to 200 milliseconds, and since the signals are memorized at the rate of 8,000 points per second for each way, a total of 500,000 data per second are thus recorded in real time on 1-inch wide magnetic tape moving at 60 inch per second, i.e. 180,000 bits per second. It is obvious that such a mass of data cannot be exploited except by a computer. The computer memory then provides figures in the form of graphs which are so accurate that they can be used to derive criteria for damage to the human body: if the damage is too great, the structure is improved... until tolerable thresholds are reached. Thus, the testing computer is directly responsible for the improvement of vehicle safety, in spite of the increasingly reduced weight of vehicles.

A Jack of All Trades

When all is said and done, the principle of CAD is universal: as long as we have memories (which is easy) and adequate computing power (for that we must rely on computer manufacturers) as well as consistent programs (they are made to measure), almost everything is possible. As a result, ergonomic problems (how to make a driving station that will suit people of extremely varied heights), problems of visibility from cars (including the rearview mirror field) are now solved by CAD. The new 305 models, including their dashboards, owe everything to these techniques which, it must be said, have been experimented for a long time. Let us add that the Vera made it possible to perform a last rehearsal of all these techniques and that its success has demonstrated their validity and formidable effectiveness.

Thanks to CAD and the mathematical prototype, that phantom consisting of innumerable equations, that "red thread," designing has become much more rapid, infitinitely more precise, and connects directly with machining equipment. Since data processing is also the language of robots, we cannot help dreaming of a prototype that would merely be defined and drawn by man and would be delivered complete and completed by the multitude of computers and robots that would have created it.

A utopia? Certainly not; we are much closer to this solution than we imagine: it will result in a levelling of techniques "at the top"--which will benefit the consumer--but will increase the importance of the initial choices--definition and style--and therefore that of the designers. Is not this what counts?

9294
CSO: 3698/58

TRANSPORTATION

BRIEFS

ITALIAN FUNDS FOR ATR-42--A first series of credits amounting to 17 billion lire (approximately 850 million French francs) will be made available to the Italian national company Aeritalia, a member of the IRI [Industrial Reconstruction Institute] group for the development and construction of the French-Italian commuter aircraft ATR-42. On the French side, the ATR-42 will be manufactured by the national company Aerospatiale; it should be placed in service starting in 1985. It will have 42-49 seats and will be designed as a commuter aircraft. The project has already received orders and options for approximately 70 units. Market studies show that world demand for this type of aircraft will reach 2,500 units during the present decade. [Text] [Paris LES ECHOS in French 26 Oct 82 p 10] 9294

COMPANY READY TO SUPPLY PARTS FOR ATR-42, A-320--On 23 September, SAMM [Motive Power Machines Applications Company] held a press conference at its Vernon plant; at this press conference the company (since 1976 a member of the Peugeot-Talbot-Citroen group) emphasized its defense and aeronautical activities. SAMM's aeronautics department accounts for approximately 30 percent of the group's total activity; it produces servocontrols, stick hand-grips, monometric switches, pumps and electric pumps. As far as weapons are concerned, it is involved in particular in the development and production of turrets for armored combat vehicles and surface ships. Quite recently, the company--which has a strong position on the market of civilian and military equipment for civilian and foreign aircraft (planes and helicopters)--was chosen by the economic interest group Commuter Aircraft to supply flap-jack hydraulic control blocks for the French-Italian ATR-42. These are computer-controlled jack-supply systems. As far as the A-320 project is concerned, SAMM has just signed a cooperation agreement with Dowty. According to one of the technical managers, "through this agreement we intend to acquire a European dimension and the means to prepare us, industrially speaking, for the next generation of aircraft which Airbus Industries is expected to develop." SAMM's 1981 global sales after tax amounted to 290 million francs, including 65 percent of export sales. [Text] [Paris AVIATION MAGAZINE INTERNATIONAL in French 15 Oct 82 p 56] 9294

CSO: 3698/51

END